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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/790,212

03/02/2004

Junichi Tanaka

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7590

05/16/2007

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EXAMINER

KACKAR, RAM N

ART UNIT

PAPER NUMBER

1763

MAIL DATE

DELIVERY MODE

05/16/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/790,212	Applicant(s) TANAKA ET AL.	
	Examiner Ram N. Kackar	Art Unit 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 4/9/2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) 7-9 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 and 10-15 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/9/2007 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. **Claims 1-6 and 10-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kagoshima et al (US Pub 2003/0003607) in view of an Article “ Modeling the impact of photoresist trim etch process on photoresist surface roughness” by Shahid Rauf et al.**

Kagoshima et al disclose an etching apparatus for etching of mask features (Fig 1 and Abstract) with plasma and a plasma monitor (3) which could be an optical emission spectroscopy to monitor the species in the plasma. Kagoshima teaches optimum recipe calculation model which depends upon the monitored result from the plasma monitor (24) and the measurement of CD (22).

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Kagoshima et al fail to disclose the roughness parameter of the resist and its impact on the recipe calculation model.

Shahid Rauf et al have extensively studied dependence of etch rate upon roughness (undulation) when all other factors remain same. They teach that the etch rate is high at the beginning if the initial roughness is high, and reduces when the roughness is reduced. So that it is essential to know the initial roughness in order to estimate etch time needed to etch to target CD. Shahid Rauf et al teach that the roughness factor (RF) is measured as in Fig 1 by R profile of the roughness part and the spatial frequency computed using Fourier transform (Page 656 Col 2).

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to provide to the optimum recipe calculation model of Kagoshima et al, not only the monitored result of the plasma monitor and the measured CD, but the initial roughness (RF) of the mask in order to deal with the effect of roughness on recipe time.

Regarding 11, this is an intended use claim.

Regarding claim 12 the article's measure of roughness as special frequency and amplitude is correlated to aspect ratio.

Response to Arguments

Applicant's arguments filed 4/9/2007 have been fully considered but they are not persuasive.

While repeating the argument against the article of Shahid Rauf, applicant states that Rauf is not directed to treating edge undulation along vertical mask side walls and concludes that

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its approach does not apply to line edge roughness. This issue has been addressed before, in the office action and the interview. The passage in question refers to the limitation of the model in a certain case of roughness caused by defect in the mask, which results in vertical striations.

In response, it does not appear that the claimed invention is solely directed to this situation. Further even if the model has some limitation in a certain case it only means that the model may require modification for those cases. It does not negate the correlation between trim time and degree of roughness.

Applicant further argues that Rauf nowhere teaches a calculating arrangement for calculating trimming conditions. This argument is not persuasive since by showing that there is a direct correlation between degree of roughness and trimming conditions it allows Kagoshima et al to improve their model which without this modification would be imperfect.

The correlation between roughness and trimming conditions is well known in arts. See Choo et al (US 6516528) and Hays (US 2003/0108235) as discussed below.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Choo et al (US 6516528) discloses that line edge roughness may be employed to adjust operating characteristics (Col 3 lines 38-43 and Col 4 lines 21-24) and Hays (US 2003/0108235) discloses that edge roughness is a part of critical dimension specification for control of semiconductor wafer process (Paragraph 07).


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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ram N. Kackar

whose telephone number is 571 272 1436. The examiner can normally be reached on M-F 8:00 A.M to 5:P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571 272 1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Ram Kackar

Primary Examiner AU 1763